

THE HESP PROJECT**K. Kai**

Tokyo Astronomical Observatory
University of Tokyo
Mitaka, Tokyo 181, Japan

ABSTRACT. A project for space observations of solar flares for the coming solar maximum phase is briefly described. The main objective is to make a comprehensive study of high energy phenomena of flares through simultaneous imagings in both hard and soft X-rays. The project will be performed with collaboration from US scientists.

The HESP (High Energy Solar Physics) WG of ISAS (Institute of Space and Astronautical Sciences) has extensively discussed future aspects of space observations of high energy phenomena of solar flares based on successful results of the Hinotori mission, and proposed a comprehensive research program for the next solar maximum, called the HESP (SOLAR-A) project. Meanwhile in February 1985 a joint discussion with US scientists was made at ISAS about the scientific objectives the collaboration between US and Japan scientists. The collaboration will cover not only hardwares but also softwares and data analyses.

The objective of the HESP project is to make a comprehensive study of both high energy phenomena of flares and quiet structures including pre-flare states, which have been left uncovered by SMM and Hinotori. For such a study simultaneous imagings with better resolutions in space and time in a wide range of energy will be extremely important. Therefore, we consider a hard X-ray telescope in 10 - 100 keV and a soft X-ray telescope to be the main instruments.

Hard X-Ray Telescope (HXT)

The fundamental requirements for HXT are as follows.

- (1) Simultaneous imagings over a wide range of energy. In particular flare images at energies higher than 30 keV are essentially important to

separate nonthermal components from thermal components. Images taken at above 50 keV would not be polluted by thermal components. Simultaneous imagings at 3 - 4 different energies between 10 and 100 keV are needed.

(2) High resolution. In order to know, for instance, whether successive spikes of impulsive flares occur in a single loop or successively adjacent loops, or whether the whole part of a loop or only its foot points brighten, the spatial resolution should be better than that of the SXT and the temporal resolution should be as short as 1 s.

(3) Wide field of view. The whole Sun coverage is desirable to catch transient flare phenomena, because we cannot predict to our present knowledge in which region flares occur.

(4) Accuracy of absolute position determination. It is crucial to compare HXR images with those of H α , microwaves, and magnetograms. The accuracy of absolute position determination of HXR images should be better than 2" - 3".

A spin-stabilized satellite is not suited for a soft X-ray telescope from a view point of loss of signal, and therefore a non-spinning satellite is desirable. As a result a HXR telescope of a rotating modulation collimeter type such as SXT cannot be adopted. Instead, a HXR telescope of a multi-grid synthesis type has been proposed by Kosugi. It is somewhat analogous to a radio interferometer of a multi-correlator type. It consists of a number of modulation collimeters (MC) with various pitches and orientations. Each MC consists of a pair of grids installed in parallel (perpendicular to the optical axis) with a separation of ~ 1 m. The response patterns for a point source are triangle. The repetition rate of the response patterns in the sky depends on both the pitch of grids and the separation. The repetition rate corresponding to the largest pitch is chosen to be $\sim 2'$, since HXR flare images rarely extend over areas of $2' \times 2'$. It is noted, however, that the field of view of HXT covers the whole Sun. We consider that ~ 100 MC's are necessary to obtain flare images of complex structure. The final number and configuration of MC's will be determined by trade-off between technical feasibility and scientific demand.

It is troublesome to prepare a separate detector for each of MC's. Instead, we use a photomultiplier as position-sensitive detectors. Thence the total number of photomultipliers can be reduced to less than 10.

Soft X-Ray Telescope

High resolution observations in soft X-rays is also crucial for understanding of not only high energy phenomena of flares but also pre-flare conditions and large scale quiet structures of the Sun. The fundamental requirements for a soft X-ray telescope is high resolutions in space and time. Magnetic field structure in flaring region and its change before, during and after flares can be investigated only with spatial resolution of down to a few arc seconds and temporal resolution of as short as 1 s. In addition simultaneous imagings at different wavelengths are also of special interest.

The soft X-ray telescope is one of important items of the Japan-US collaboration. The optical system and detector will be provided from US

scientists and the data processor from Japanese scientists.

Other Instruments

In addition to hard and soft X-ray telescopes, X- γ ray continuum spectrometers, a Bragg crystal spectrometer, and a solar intensity monitor are candidates for supporting instruments. Which instruments are to be aboard will be decided after the design of the two telescopes has been fixed.

Satellite

The satellite will be launched by a M-3S-II rocket on a near circular orbit of ~ 600 km altitude. The total weight allowed for scientific payload will be limited to ~ 140 kg.